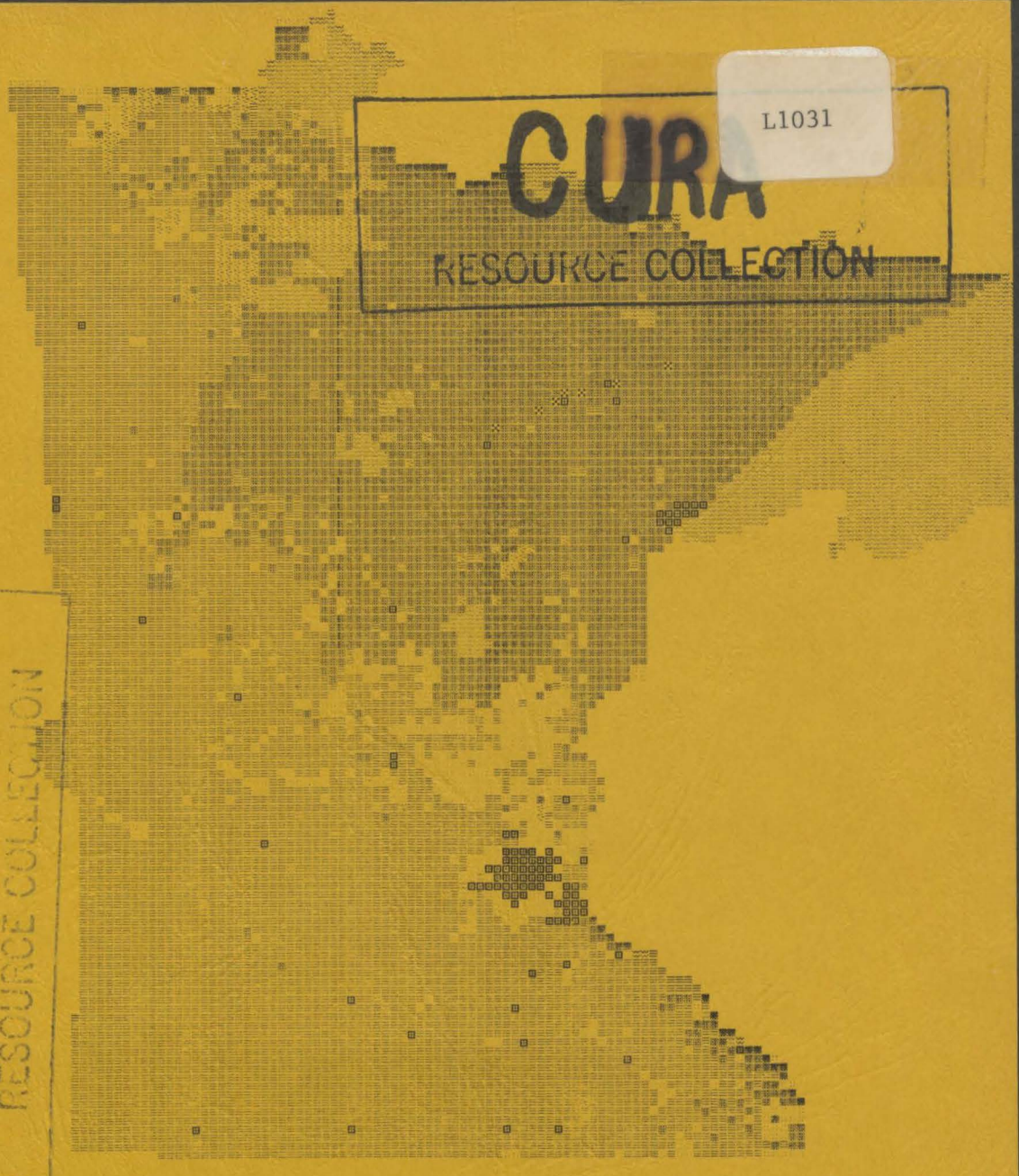


MLMIS

MINNESOTA LAND MANAGEMENT INFORMATION SYSTEM

Wildlife Habitat Change and Seasonal Cultivation. CURA/SPA. by Dwight Brown et al. 1975.

COPY 1

MINNESOTA LAND MANAGEMENT INFORMATION SYSTEMS (MLMIS) (CURA)

Wildlife Habitat Change and Seasonal Cultivation. CURA/SPA. by Dwight Brown et al. 1975.

COPY 1

MINNESOTA LAND MANAGEMENT INFORMATION SYSTEMS (MLMIS) (CURA)

UNIVERSITY OF MINNESOTA
CENTER FOR URBAN AND
REGIONAL AFFAIRS

STATE PLANNING AGENCY

WILDLIFE HABITAT CHANGE AND SEASONAL CULTIVATION

5012

DWIGHT A. BROWN
JOHN A. HARRINGTON
TOM ISLEY
DAVE SOEHREN
JOHN M. SMILEY
ELIAHU STERN

1975

FORWARD

This report is the outcome of a project funded by the National Aeronautics and Space Administration (NASA) and initiated by the Minnesota State Planning Agency (SPA). The project is structured to examine the feasibility of updating the land use and land cover information contained in the computerized data of the Minnesota Land Management Information System (MLMIS). The source of updating information for this and two other reports of similar purpose is the imagery obtained from a NASA earth-orbiting satellite (ERTS-1). The evaluation of the feasibility of using ERTS imagery for these purposes has been undertaken by faculty and staff members of the University of Minnesota Departments of Forestry, Soils, and Geography, through the Center for Urban and Regional Affairs (CURA).

Wildlife Habitat Change and Seasonal Cultivation

Dwight A. Brown[1], John A. Harrington[2], Tom Isley[3],
John M. Smiley[1], Dave Soehren[3], Eliahu Stern[1]

In response to the expressed needs of Minnesota Department of Natural Resources (MDNR) game biologists, a cooperative project was established to evaluate the application of ERTS-1 derived seasonal cultivation maps to wildlife habitat planning and management.

The wildlife habitat study evolved from agricultural land use investigations that used a monitoring and aggregation system, to obtain an accurate inventory of cultivated land from ERTS-1 images (Graber et al, 1973, pp. 18-23). The intermediate stage maps were examined by game biologists in MDNR, who determined that this periodic-type of information was useful in planning wildlife habitat programs. As a result, a demonstration project was established that encompasses seven townships in West-Central Minnesota. The following is a description of the methods, results, and comparative cost estimates of this study.

Procedures

The test sites were selected by MDNR regional game biologists based at Madelia, Minnesota. Fortunately, the seven townships selected in Traverse, Grant, and Wilkin Counties are located in the coverage overlap area of two orbital paths, thus maximizing the probability of regular cloud-free coverage (Figure 1). All seven towhships are located on the flat Pleistocene Lake Agassiz Plain, where cultivated farmland exceeds 95% of the total land area of most townships. Field sizes are larger than the average for Minnesota.

[1] Department of Geography, University of Minnesota, Minneapolis, Minnesota
[2] Department of Geography, Michigan State, East Lansing, Michigan
[3] Minnesota Department of Natural Resources

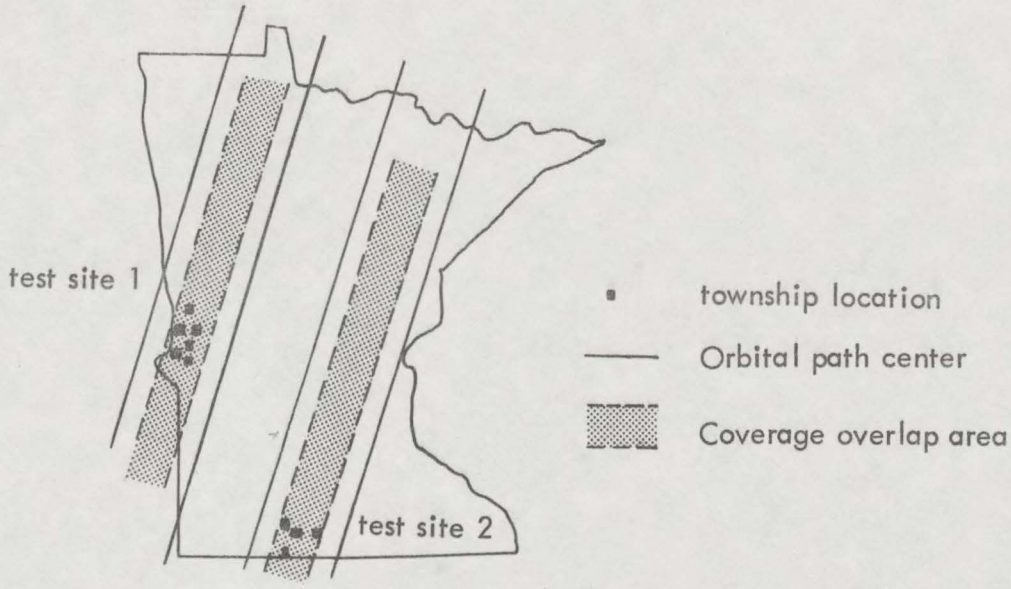


FIGURE 1 - Location of test sites

To assess the accuracy of ERTS-1 based maps a second study area of four townships was chosen, where field data on cultivation was monitored under the MDNR "Operation Pheasant" program (Fig. 1). The field data were sufficiently detailed to allow evaluation not only of amount of cover-free land but also of field location error and of field conditions that resulted in confusion. Subsequently, several changes in the ERTS mapping program were made that we hoped would increase accuracy and speed of interpretation.

For the second study area (Fig. 1), township-centered 35mm color slides were taken of back-lighted ERTS-1 system corrected color transparencies. These slides were projected onto wall mounted 1:62,500 scale base maps with a zoom lens projector. The larger scale was chosen to make the products compatible with maps, produced by MDNR personnel, based on ground investigation and low altitude 35mm aerial photography. Corrected color images were used because it was determined that young emerging crops would be more easily interpreted with red-black contrast color film than with grey-black contrast black

and white. The MDNR had undertaken ground-truth mapping on 6 August 1972, 7 April 1973, and 15 July 1973. ERTS images taken on days with no more than 10% cloud cover, and within one month of MDNR's data, were selected for interpretation.

The evaluation showed marked seasonal variations in the quality of the results. Summer period (15 July 1973) mapping was highly inaccurate. Comparison of the ERTS-derived maps and ground truth maps highlighted the kinds of interpretive errors caused by using summer images. The major reasons for interpretation error using summer images can be summarized as follows:

(I) Color-contrast was minor.

(II) Bad satellite scan lines interrupting field patterns.

(III) Rapid decay of black tones due to drying. Dark tones are a function of surface moisture content. Dryer fields are difficult to distinguish from some unplowed areas.

(IV) Immature or late crops may be interpreted as plowed fields (e.g.: late beans and corn as well as flooded areas are often picked up as plowed or possibly plowed).

Interpretation of spring images provided an accurate assessment of the acreage of cover-free land carried over the winter. The "Operation Pheasant" maps of cover-free land during winter are included along with the ERTS derived maps of the second study area (Fig. 13). The statistical comparison of winter carry-over of plowed land for the four-township test area is shown in Table 1. The correspondence between the data from the two sources is sufficiently close enough to warrant comparative cost analysis. The following cost comparison was based on the production of the maps in Figure 13.

TABLE 1

Comparison of Plowed Land Carried Over Winter[1]

Township	Percent Plowed		Percent Possibly Plowed		Percent Other	
	Air Photo	ERTS	Air Photo	ERTS	Air Photo	ERTS
Galena-Waverly, Martin Co.	74.0	72.7	2.7	9.6	23.2	17.6
Jay-Lake Fremont, Martin Co.	66.3	60.7	9.4	14.3	24.7	24.8
Odin, Watonwon Co.	70.2	71.0	2.0	10.8	27.8	18.0
Nashville-Center Creek, Martin Co.	71.1	66.8	1.3	16.8	21.6	16.2

Cost Comparisons

Three methods of mapping winter carry-over of plowed fields provide the basis for comparison of costs for the four townships in Test Site 2. Ground Mapping assumed that the field crew would be based in Madelia, Minnesota, and that all field work require staff to stay in the field for the whole period while drawing per diem expenses (Table 2). The cost shown would be the maximum for the four-township study because many areas would not require overnight

1. The Air Photo analysis was part of MDNR project "Operation Pheasant" and included extensive ground observations. The dates for Air Photo coverage and ERTS coverage may vary as much as one month. Part of the discrepancy in the figures can be explained by very early spring plowing in this lag period.

stays by regional agency personnel during the mapping. Clearly the cost of ground mapping, which results in the lowest level of field boundary accuracy of the three methods, is too high for consideration in even moderate sized studies.

TABLE 2

Projected Cost Comparisons for Three Methods of Mapping Winter Carry-over of Plowed Land for Four Townships (144 sq. miles) in South-Central Minnesota

	Ground Mapping	Light Aircraft Photography	ERTS-I Imagery
Travel Manhours [1]	128 hrs. $896	12 hrs. $84	---
Office Manhours [1]	16.8 hrs. $118	50 hrs. $350	7 hrs. $49
Automobile [2]	1788 mi. $250	80 mi. $11	---
Aircraft & Pilot [3]	---------	5 hrs. $135	---
Fuel Consumption [4]	179 gal.	55 gal.	---
Supply costs [5]	$10	$63	$10
Field Subsistence [6]	15 days $487	------	---
Total costs	$1761	$643	$59
Cost per sq. mi.	$12.23	$4.46	$.41

[1] Man hours are charged at a $7/hour rate.

[2] Automobile travel is charged at 14¢/mi.

[3] Pilot and aircraft are charged at $27/hr.

[4] Fuel consumption is figured at 8 mpg. for field mapping, 14 mpg. for highway driving and 11 gal./hr. for aircraft.

[5] Supply costs include drafting materials, film, and camera depreciation.

[6] Field subsistence is figured at $32.50/day away from home base.

The 35mm air photos that provide the basis presently for habitat data collection are considerably less costly than field mapping. 35mm aerial photography provides slightly more accurate results for total plowing than either of the other two methods. This should be considered when comparing costs. The photos and field boundary locations also permit detailed analysis of habitat conditions and augment simple analysis of plowing.

ERTS-derived maps of plowed land are substantially less expensive than field mapping or low altitude photography and are particularly efficient from an energy standpoint. The quality of results are highly comparable to small frame aerial photography, except for the problem of field boundary locations. The very low cost of ERTS images must be weighed against the limitations in availability of data presented by the 18-day orbital cycle of ERTS. At times, the need for data between the dates of the ERTS orbit is critical.

Conclusions

ERTS-1 imagery has been demonstrated to have an accuracy level approximating that of small frame aerial photography in studies of plowed land carried-over winter. A variety of factors limit its accuracy at other seasons. Cost analysis shows that ERTS-derived maps of plowing are by far the cheapest of the three methods examined and the system shows considerable promise for large area studies. The most critical limitation for the use of ERTS imagery in studies of cover-free land carried over winter is the uncertainty of cloud-free coverage during the short useful time period.

References

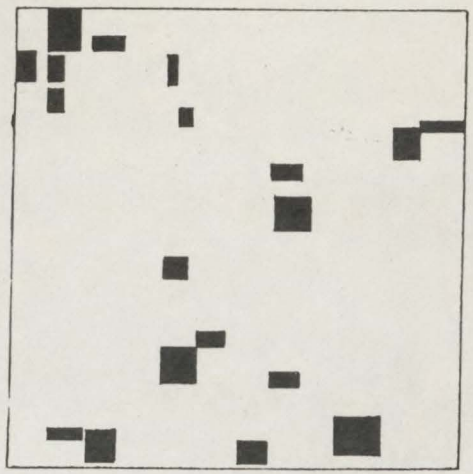
Graber, Linda, Brown, Dwight, and Harrington, John, 1973, "ERTS-1 Applications to the Mapping of Agricultural Land Use in Minnesota," in Sizer et al. Application of ERTS-1 Imagery to State-Wide Land Information System in Minnesota, 17-25.

Acknowledgement

This work was partially supported by NASA contract NAS5-21801.

MAP

APPENDIX



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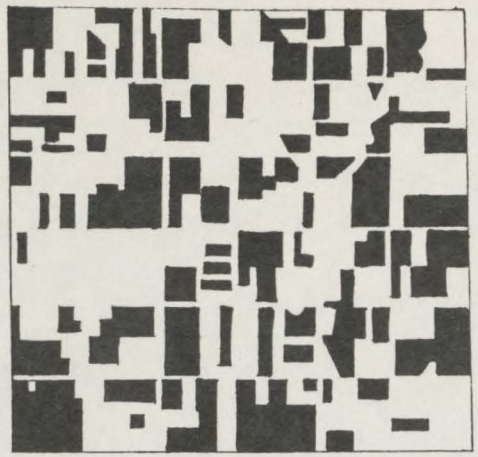
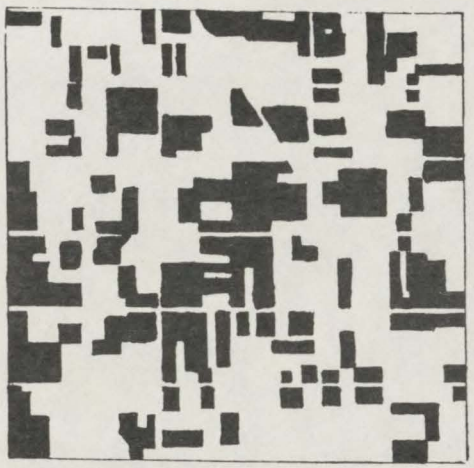
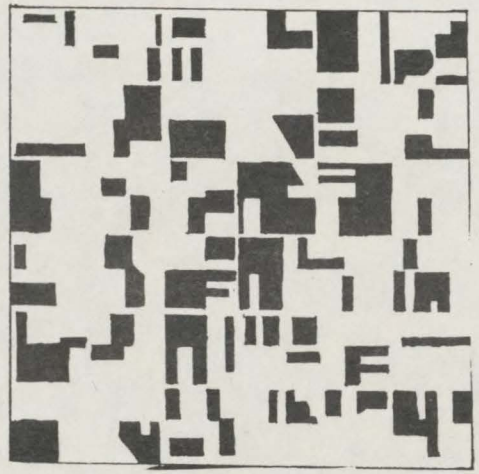


21 September 1972

8, 9 October 1972



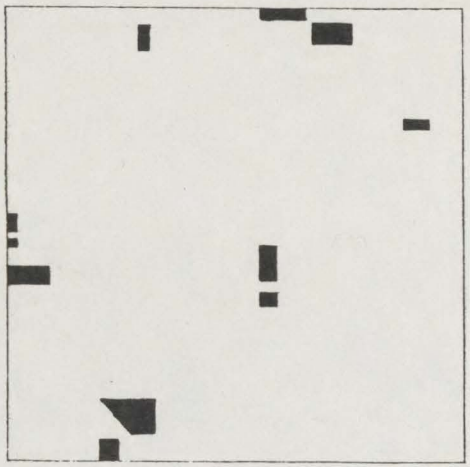
30, 31 May 1973



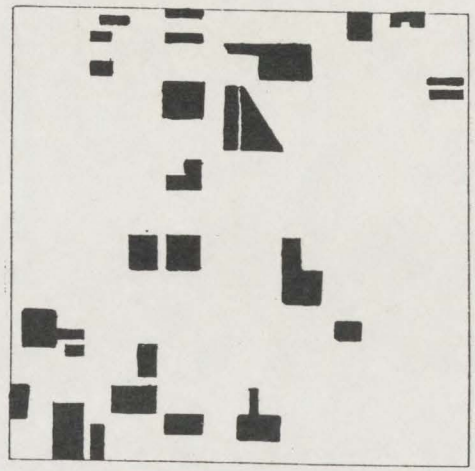
17 June 1973

Composite

FIGURE 2 - Bare, plowed fields for five dates and composite map for Croke Township, Traverse County, Minnesota. August, 1972 - June, 1973.



5, 6 July 1973



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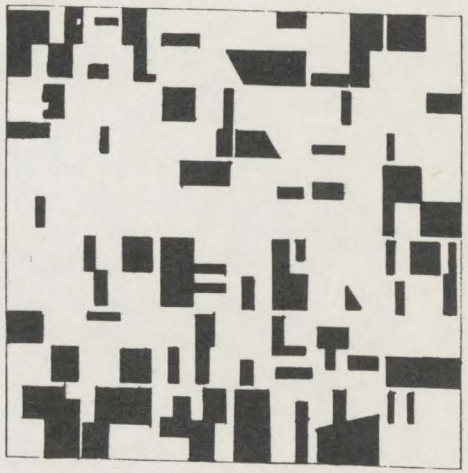
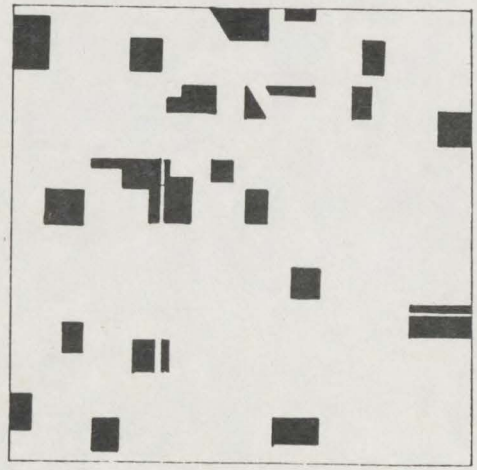
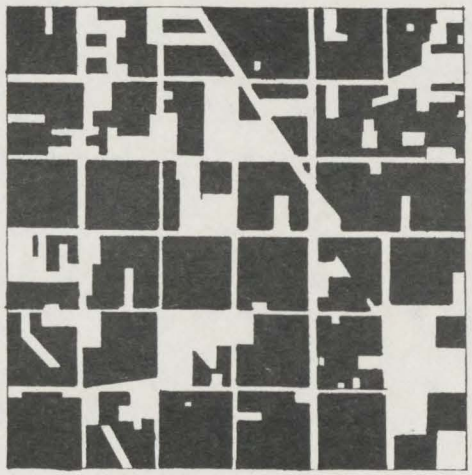


28, 29 August 1973



4 October 1973



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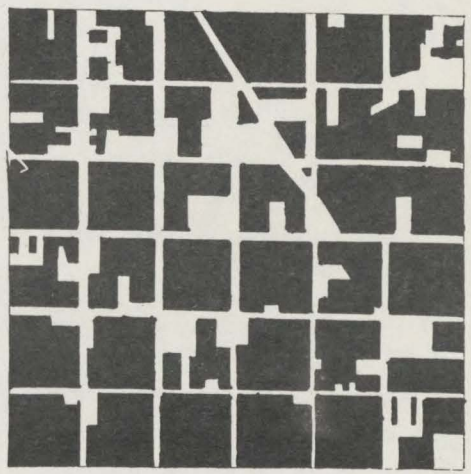
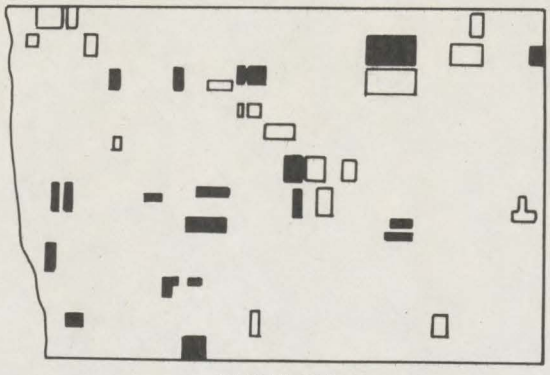


Composite

FIGURE 3 - Bare, plowed fields for five dates and composite map for Croke Township, Traverse County, Minnesota. July through October, 1973.

FIGURE 4 - Plowed fields - West Central Minnesota, August 16, 1972
from ERTS - 1 Image 1024-16484 Scale - 1 : 205,000

Plowed Field Possibly Plowed Field



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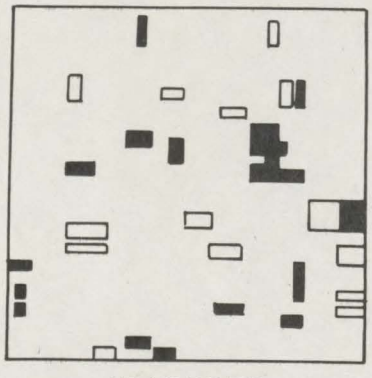

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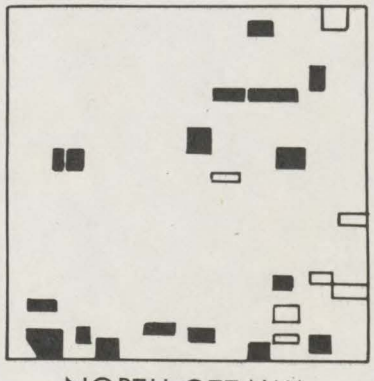
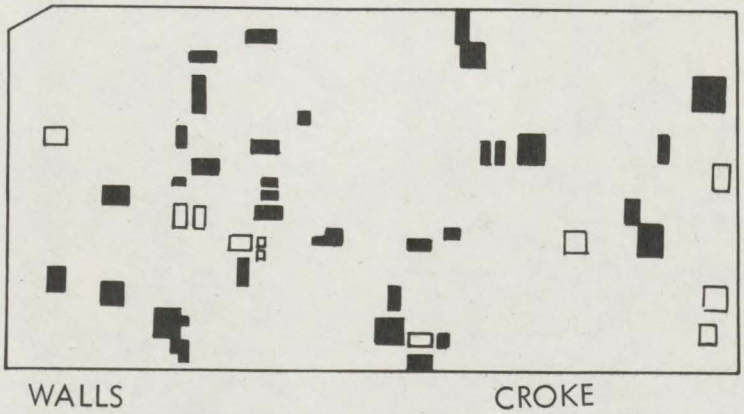
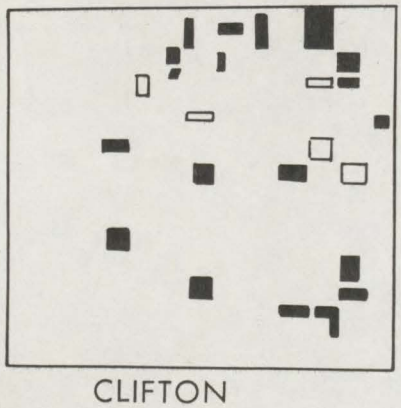


NORTH OTTAWA



WALLS

CROKE



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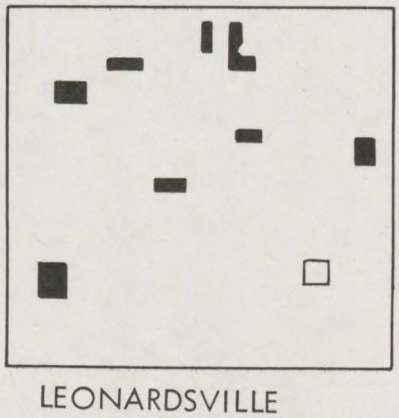

LEONARDSVILLE

FIGURE 5 - Plowed fields - West Central Minnesota, September 21, 1972
from ERTS - 1 Image 1060-16485 Scale 1 : 205,000

Plowed Field Possibly Plowed Field

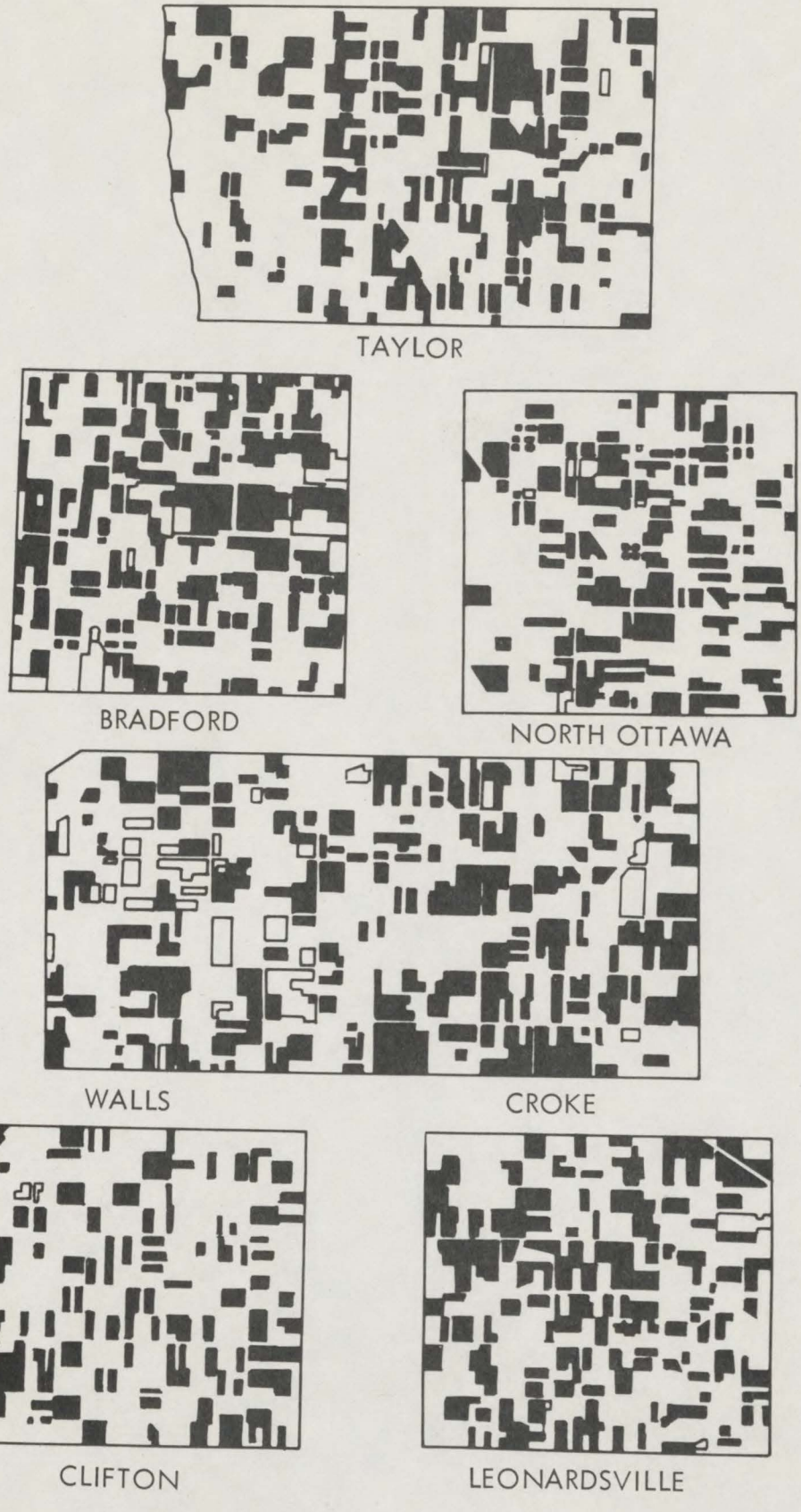

FIGURE 6 - Plowed fields - West Central Minnesota, October 8 and 9, 1972
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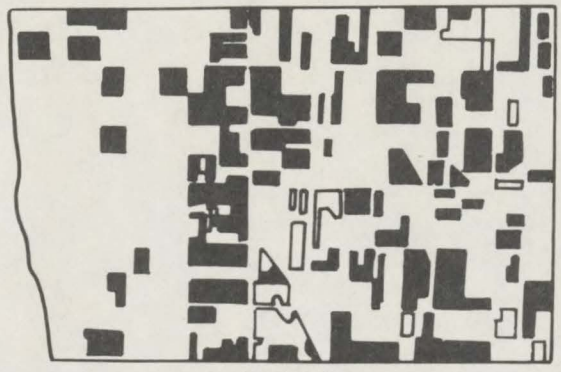
Plowed Field Possibly Plowed Field



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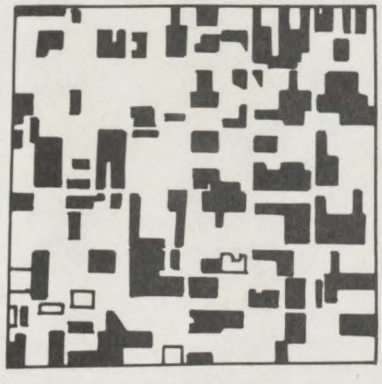
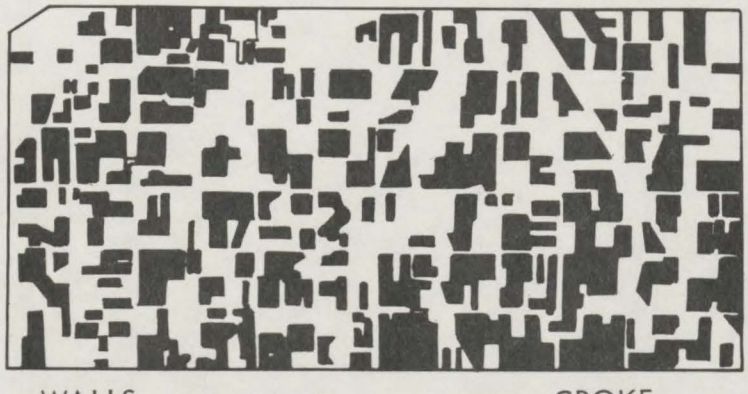


BRADFORD

NORTH OTTAWA



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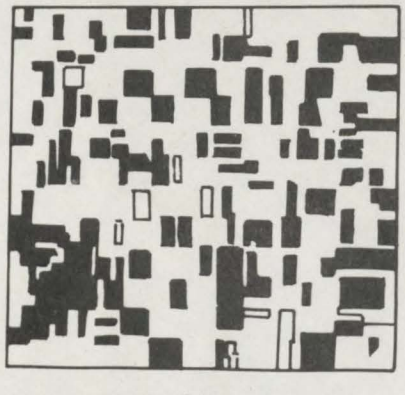

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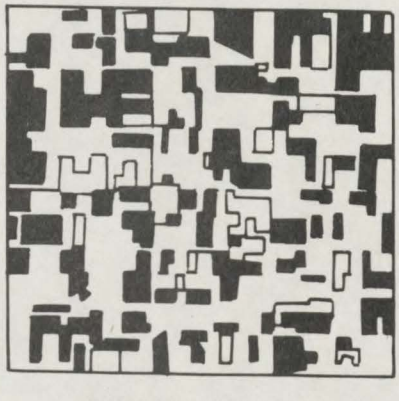
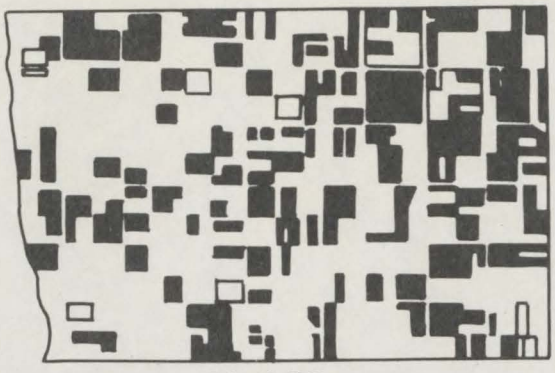


LEONARDSVILLE

FIGURE 7 - Plowed fields - West Central Minnesota, May 30 and 31, 1973
from ERTS - 1 Images 1311-16435 & 1312-16493 Scale 1 : 205,000

Plowed Field Possibly Plowed Field



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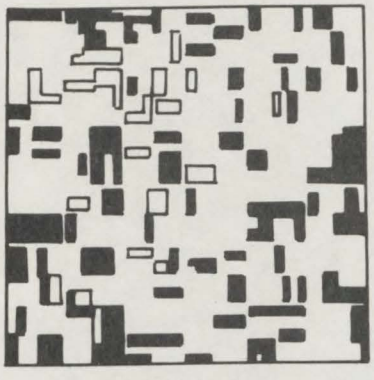

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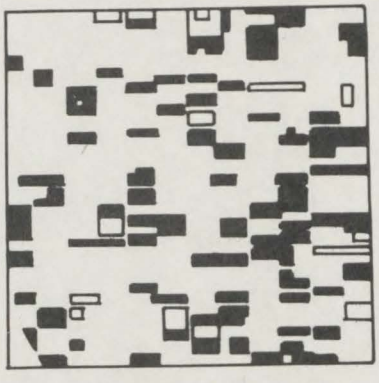

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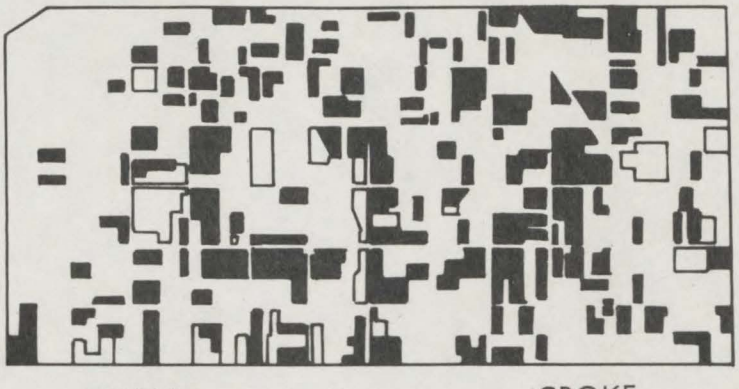

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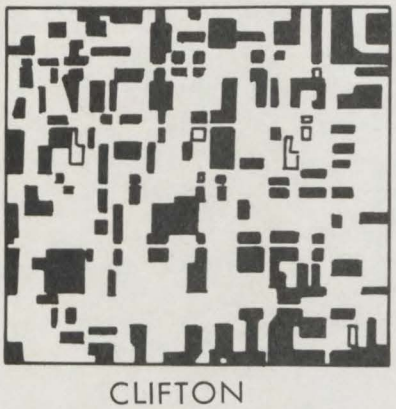

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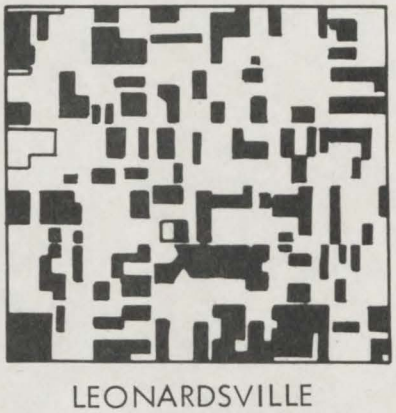
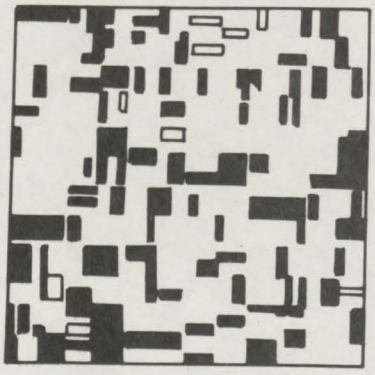


LEONARDSVILLE

FIGURE 8 - Plowed fields - West Central Minnesota, June 17, 1973
from ERTS - 1 Image 1329-16434 Scale 1 : 205,000

Plowed Field Possibly Plowed Field

TAYLOR



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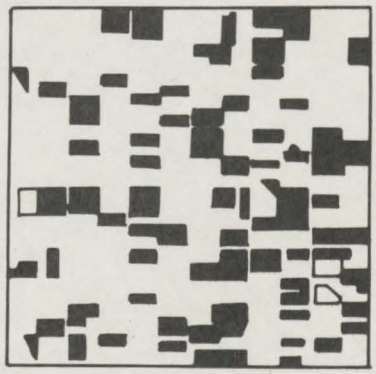

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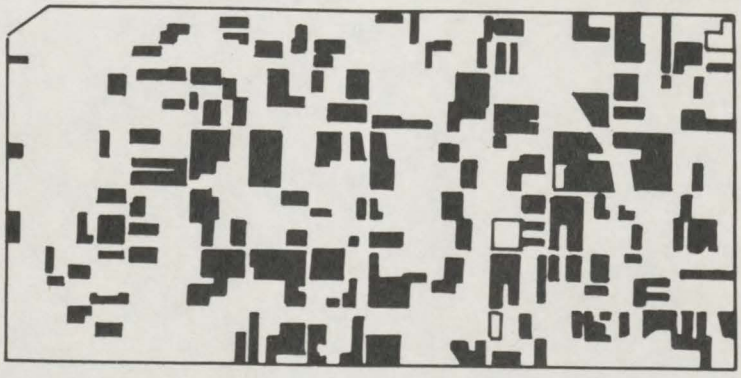

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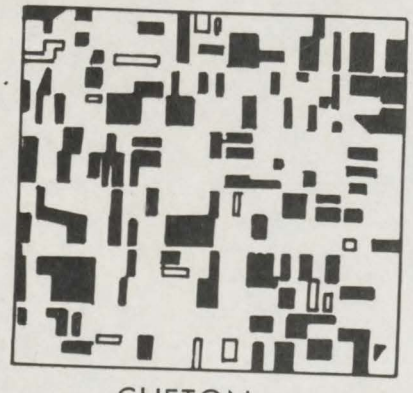

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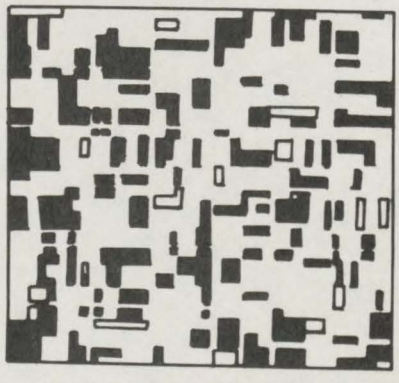


LEONARDSVILLE

FIGURE 9 - Plowed fields - West Central Minnesota, July 5 and 6, 1973
from ERTS - 1 Images 1347-16432 & 1348-16491 Scale 1 : 205,000

Plowed Field Possibly Plowed Field

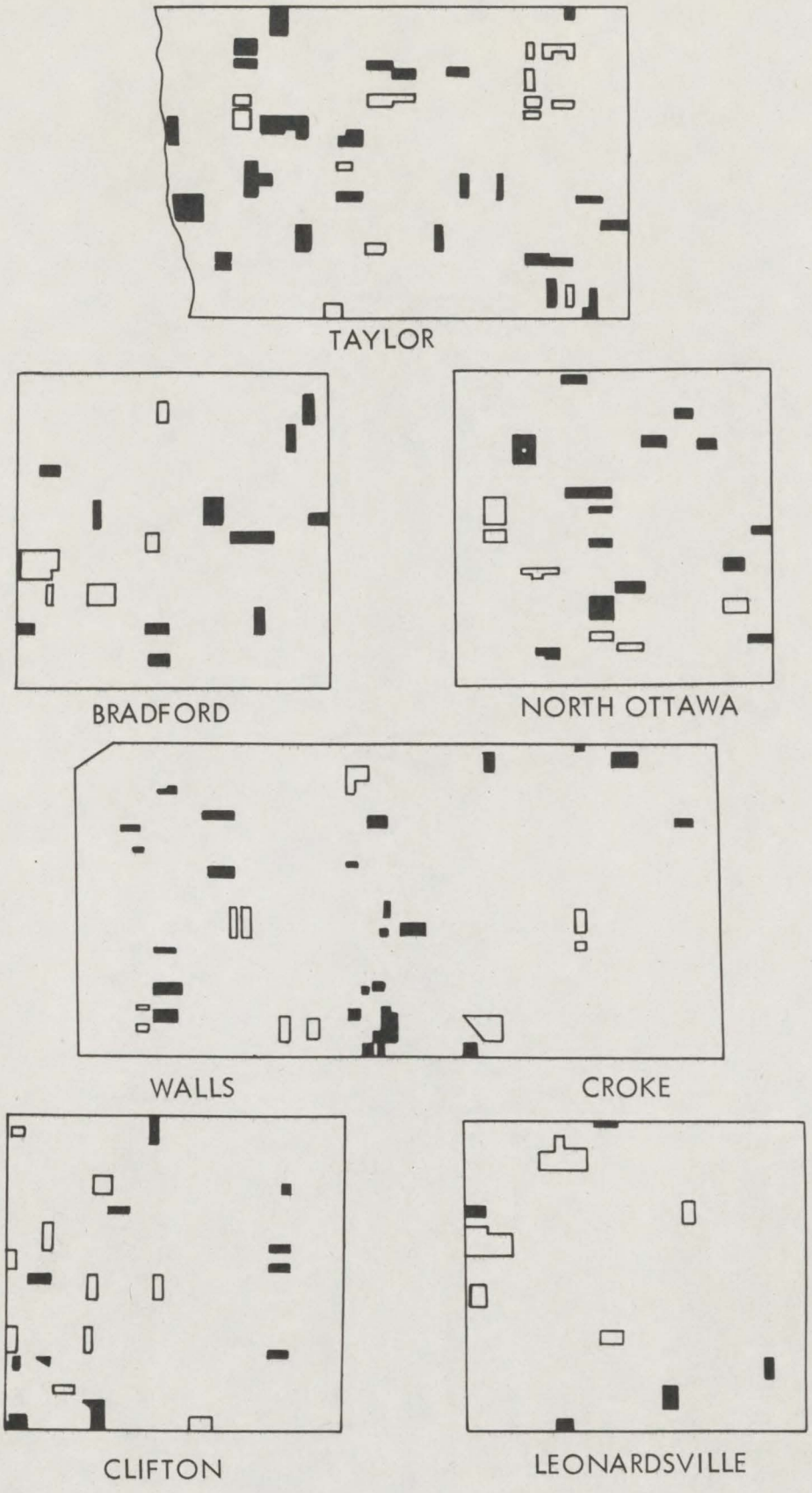
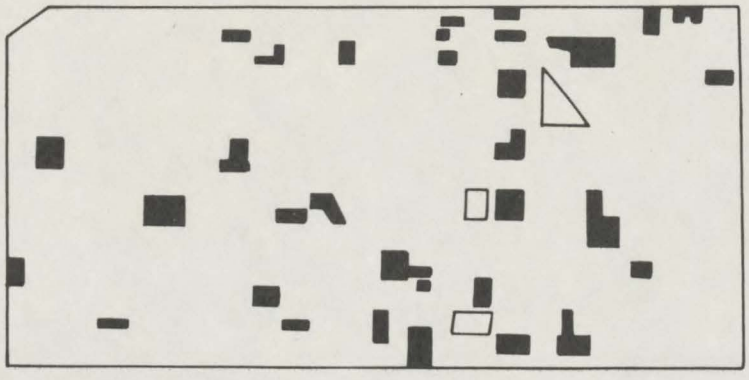
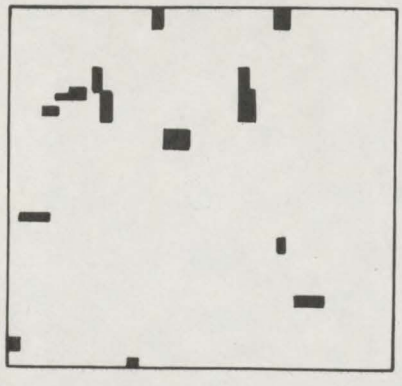


FIGURE 10 - Plowed fields - West Central Minnesota, August 10, 1973
from ERTS - 1 Image 1383-16430 Scale 1 : 205,000

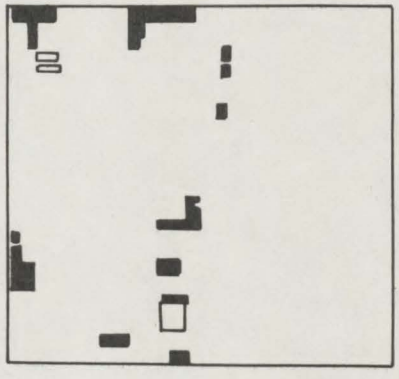
Plowed Field Possibly Plowed Field



WALLS CROKE



CLIFTON



LEONARDSVILLE

FIGURE 11 - Plowed fields - West Central Minnesota, August 28 and 29, 1973
from ERTS - 1 Images 1401-16424 & 1402-16482 Scale 1 : 205,000

Plowed Field Possibly Plowed Field

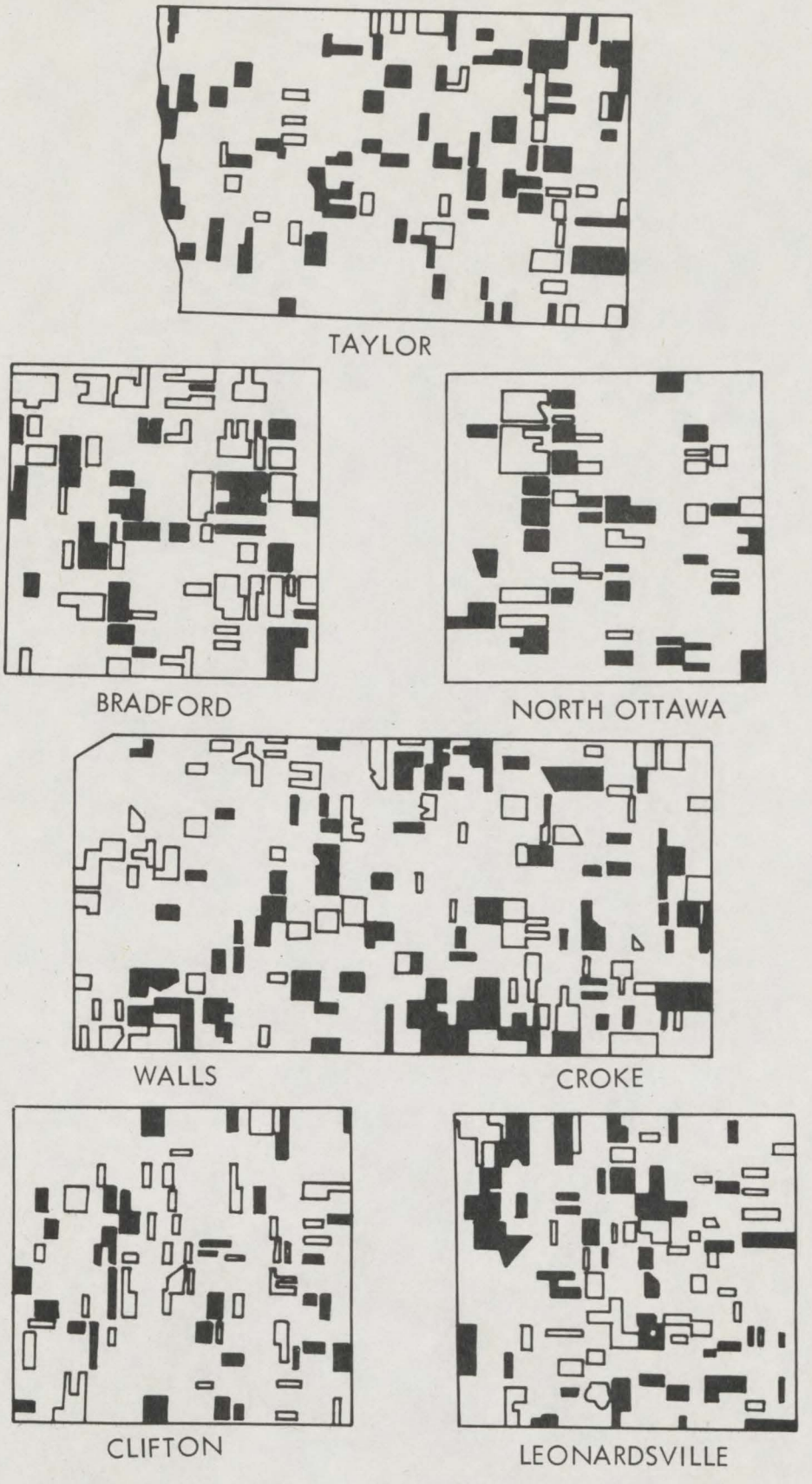
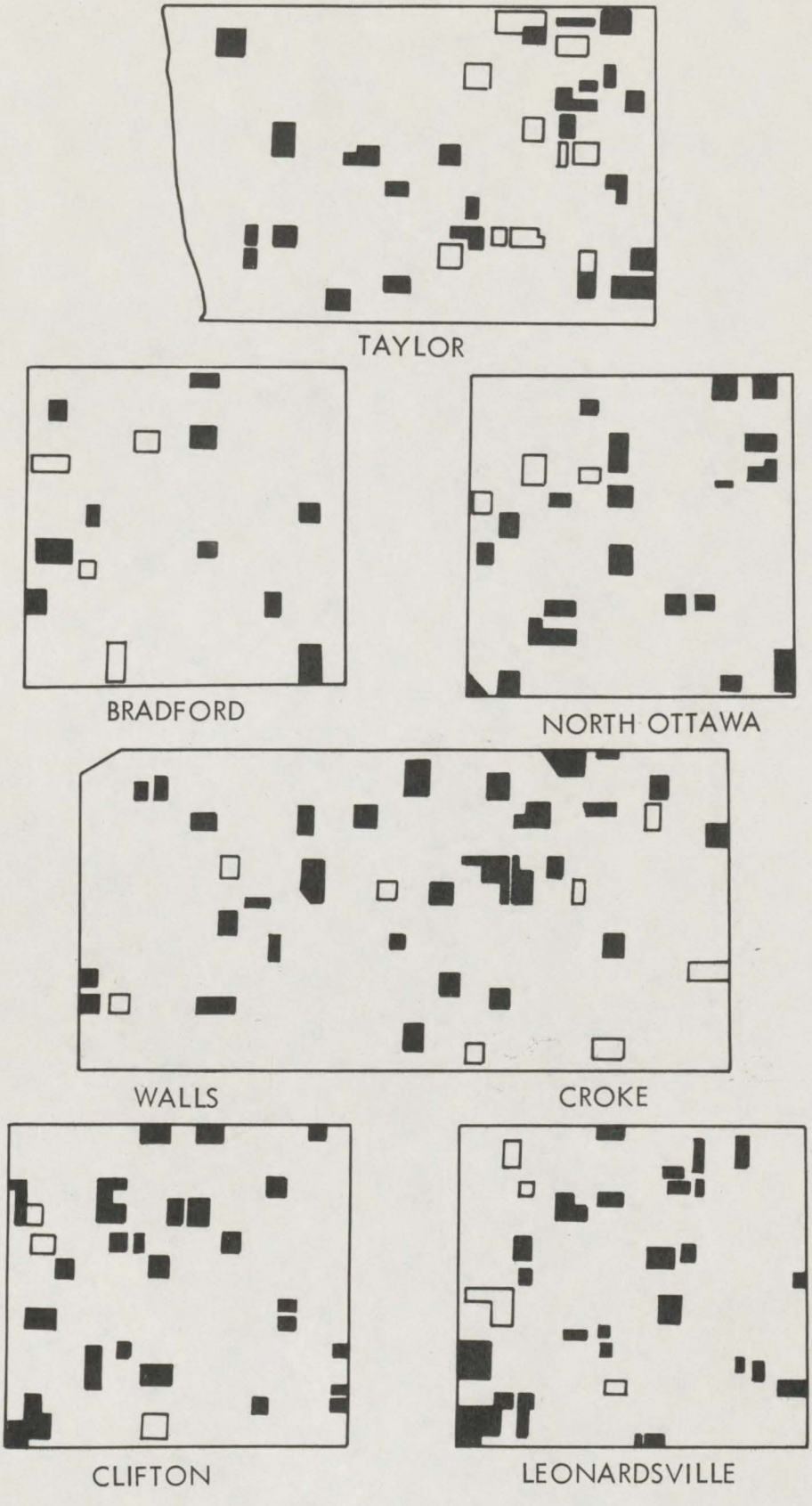


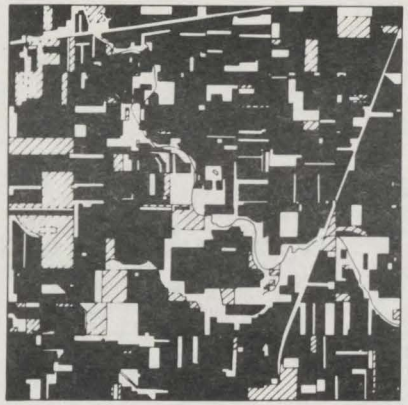
FIGURE 12 - Plowed fields - West Central Minnesota, October 4, 1973
from ERTS - 1 Image 1438-16473 Scale 1 : 205,000

Plowed Field Possibly Plowed Field

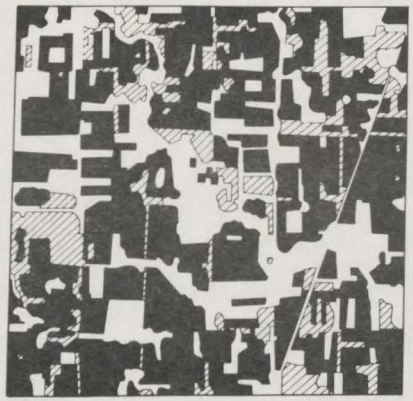


Jay Lake-Fremont, Martin Co.

Operation Pheasant

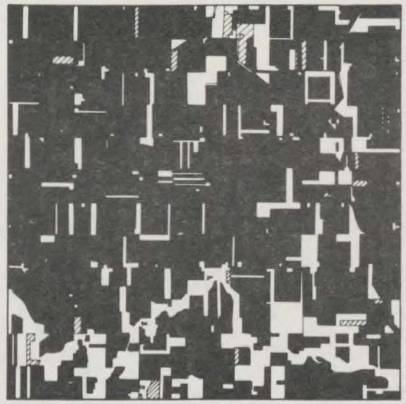


ERTS

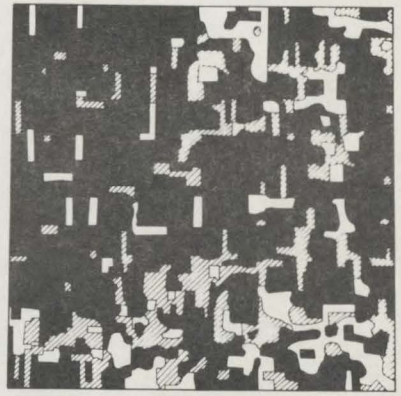


Nashville-Center Creek, Martin Co.

Operation Pheasant

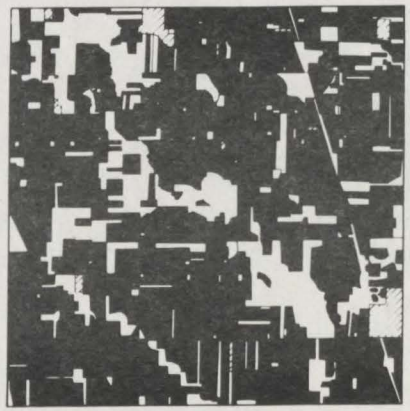


ERTS

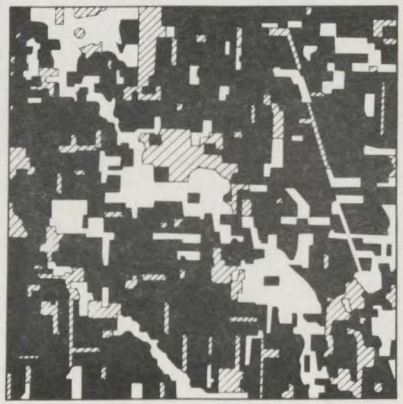


Odin, Watonwan Co.

Operation Pheasant

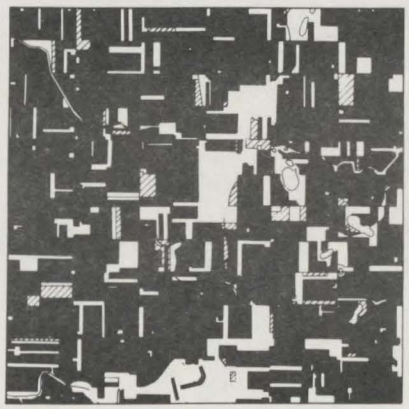


ERTS



Galena-Waverly, Martin Co.

Operation Pheasant



ERTS

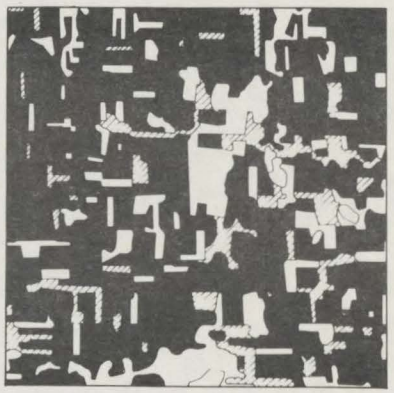


FIGURE 13 - Comparison of ERTS interpreted cover free land carried over winter with "Operation Pheasant" maps for test site 2, spring 1973. Black areas are plowed and diagonal lines represent possibly plowed. Scale = 1:190,000.